Before the Federal Communications Commission
Washington DC 20554

In the Matter of	)
	)
Amendment of Part 97 of the Commission's	) WT Docket No. 16-239
Amateur Radio Service Rules to Permit	)
Greater Flexibility in Data Communications	) RM-11708

Comments in Support by Steve Waterman, K4CJX

1. Personal Background

I, Steve Waterman, have had an Amateur radio license since 1955. My interest in Amateur radio led me to seek a career as both vice president of an independent telecommunications company, a network design business, and as a vice president for a non-regulated subsidiary of a Bell Operating Company in telecommunications and network design. Currently, in my retirement, I serve as a volunteer for various civil authorities, including county and state governments' emergency management (TEMA), my Homeland Security District Communications Committee, and Federal agency committees such as the FEMA RECCWG and NCC SHARES. Thus, my profession has always been closely related to my hobby and now, my retirement volunteer work.

On the ham side, I have been involved with the Winlink system and software, and its predecessors, since their inception. In my retirement, I currently serve as president of the Amateur Radio Safety Foundation, a 501c3 organization that supports the worldwide Winlink systems and software. I currently also serve as a member of the Winlink development team, and as the worldwide Winlink network administrator for both Amateur radio and government radio activities. I have been a member of the ARRL for over 40 years, and currently serve as an Assistant Director in supporting the ARRL Delta Division Director. I have also served on the ARRL ad-hoc digital committee.

My comments follow:

2. Introduction

I strongly support the FCC's proposal to liberalize the rules for amateur HF digital communications. To quote remarks given by Dale N. Hatfield (W0IFO), former Chief, Office on Engineering and Technology, Federal Communications Commission at AMRAD's 25th Anniversary Dinner, Falls Church, VA, June 17,

2000, speaking about the role of Amateur Radio in the new century, (We must) “provide the opportunity or ‘headroom’ for increases in data rates to more closely match those available on wireline networks and, in the future, on commercial wireless networks as well," and he goes on to quote: "as the rest of the telecommunications world makes the transition to digital techniques - and there are very few exceptions to that trend - the amateur service will look antiquated if it is not making progress in that direction as well.”

Mr. Hatfield’s vision was obviously accurate, and is certainly amplified today as we move into a world that is either “wired or wireless,” and the Amateur service is no exception. The move by the Commission to remove the symbol rate limit without imposing a bandwidth restriction is certainly in keeping with the advancement of the radio art.

3. Discussion - Symbol Rate Limits Should Be Abolished

Symbol rate limits essentially have no meaning, and I applaud the Commission's proposal to eliminate them. In quoting Philip R Karn, Jr., KA9Q, formerly communications R & D with Bell Telephone Laboratories, Bell Communications Research, and Vice President of Technology for QUALCOMM, “Even if one assumes for sake of argument that occupied bandwidths should be regulated, there is only a loose correlation with symbol rate. Although the Nyquist Theorem states that a symbol rate of 1 baud must occupy at least 1 Hz to prevent the ‘smearing’ of adjacent symbols (‘inter-symbol interference’ or ISI), many systems use more than one Hz per baud to ease filter design and/or to reduce the peak-to-average power ratio so the signal can be amplified more efficiently.

Conversely, ‘partial response’ schemes use *less* than 1 Hz per baud with intentional, carefully designed ISI that can be removed with error correction techniques. Discouraging such techniques is just one example of the unintended effects of the present rules.

The channel symbol rate and user data rate are also only loosely associated. In modern systems, the symbol rate can be either higher or lower than the user data rate. For example, in binary FSK or PSK with error correction, the user data rate is only a fraction of the channel symbol rate. With "high order" modulation schemes such as QAM or M-ary FSK, the user data rate can be greater than the symbol rate even when error correction is included. All these schemes have their advantages and disadvantages, and choices should be driven by technology and efficiency, not arbitrary regulations.”

In reviewing comments sent to the FCC for this Docket, the majority of both positive and more so, negative comments, seem to stray away from the immediate subject of symbol rate and its impact. Perhaps it is a

misunderstanding how restricting the symbol rate impacts digital protocol efficiency, or perhaps it offers a means to protect the status quo. Many of these comments are emotional outcries that do not pertain to either the symbol rate issues, or their occupied bandwidth. They have more to do with “my mode” spectral protection, a concept that should certainly be self-regulated at best. It would be more productive for those who want more or less spectrum, or “Mode protection by bandwidth” to write their own NPRM rather than vent with comments on this Docket. Regardless, the fact remains that with no symbol rate imposed on new and enabling technologies, more actual data will be pushed with less bandwidth than is possible today. As example, the current delta in throughput between the now allowable Pactor 3 (3600 bps), and the now not-allowable Pactor 4 (5500 bps) protocols is an excellent example of the higher throughput with the slightly less bandwidth of the Pactor 4 protocol even though Pactor 4 has a much higher symbol rate of 1800 baud. As it stands today, with a 300 baud symbol rate, such enabling technology is at a standstill, and the imposed restriction does not allow enhanced efficiencies necessary reduce power or increase throughput per bandwidth. In other words, it impedes those who wish to enhance the radio art.

4. Discussion - Bandwidth Limits Should not be imposed.

The occupied bandwidth situation is just as complex, and I agree with the Commission that such limits are unnecessary. Again, I quote Phil Karn, “Maximizing spectral efficiency is much more than just minimizing bandwidth; in fact, this often makes things worse! This is especially true in a shared, decentralized service like amateur radio. It is counterintuitive to many hams, but it is an established principle of communications engineering that bandwidth and power are direct trade offs. More bandwidth often allows the use of less transmitter power to reliably send data at the same rate. And transmitter power is just as much a factor in interference as occupied bandwidth -- often more.

Forward error correction (FEC), e.g., with Viterbi or Reed-Solomon decoding, is the usual way to spend bandwidth to save power. But amateurs have shown in recent years that carefully combining FEC with M-ary FSK modulation (more than just two ‘tones’) as in WSPR and JT9 performs astonishingly well on HF at extremely low power levels despite its seemingly "wasteful" use of extra bandwidth. It is routine to get solid copy of these signals even when they're totally inaudible to the ear and thus obviously unable to interfere with traditional CW or SSB signals. Tight bandwidth limits perversely penalize such power-efficient, state of the art schemes.

Relaxing bandwidth limits can also promote the use of ‘frequency diversity,’ which is especially useful on HF. It is common for users of narrowband modulation, especially traditional RTTY and CW without error correction, to use a

lot of extra transmitter power to ‘ride through’ deep fades. But ionospheric fading is frequency selective, and a narrow signal has a good chance of disappearing completely into a fade. If the redundancy added by error correction coding can be applied over frequency as well as time, it is much more likely that enough of it will get through to be successfully decoded and reducing the incentive to use excessive transmitter power.”

5. Conclusion

With the advancement of digital protocols, and their transmission techniques, the Commission should certainly stick to its guns by eliminating limits on both symbol rate and bandwidth for digital modulation on HF. This can only accelerate the recent significant advancements made by radio amateurs in developing new, spectrally efficient digital modulation schemes. The amateurs themselves are in a much better position to devise band plans as desired, and to change them to fit varying needs.

The Commission's rules are currently more than sufficient to handle any abuses that may still occur. For example, not only are amateurs limited to a transmitter power of 1500 W PEP (less on some bands and in some areas) but also by 97.313(a) to the minimum power necessary to carry out the desired communications. Better adherence to this rule --now honored more in the breach than the observance -- would do far more to minimize interference and maximize equitable spectrum sharing than limits on bandwidth or symbol rate, especially since these limits actively discourage the development and use of more power-efficient communication schemes. In addition, with the severe restrictions imposed by 97.221, which limits most unattended operations greater than 500 Hz to extremely narrow sub-bands, the fears of those who complain about digital mode interference, are not justified. After all, more than 5000 daily US Amateurs operate within the 5 to 15 KHz bandwidth limits, imposed in Part 97.221, with their 2.2 KHz bandwidth signals. They do so effectively and efficiently, and with the assistance of the Commission, this spectral efficiency can only improve. Regardless, this certainly handles the concerns of Amateurs to police themselves rather than rely on the Commission to do all the work for them, especially during special events and contests using any signal type.

The Commission's existing rules are entirely adequate, particularly the explicit mention of intent in the definition of "encoding" (i.e., encryption) in 97.113 (a)(4) as "for the purpose of obscuring meaning." There is a huge chasm between open compression and encryption. Those who complain that they cannot copy certain protocols must only have the correct hardware and software to do so. Those who cannot copy CW, or have no CW “reader,” cannot monitor it effectively. A radio without a product Detector cannot copy SSB, and those who complain about not being able to monitor an open compressed binary format only need the right

equipment and software. This emphasis on intent, as opposed to any incidental effect on ease of monitoring by third parties, is crucial. Efficiency improvements made to a radio communications system will unavoidably also make it harder to monitor. This extends well beyond the use of data compression to reduce the number of bits in a message and therefore transmitted energy and spectral occupancy.

Again to quote Phil Karn, “If ease of monitoring were the sole criterion, one could construe even compliance with the mandate in 97.313(a) to ‘use the minimum power necessary to carry out desired communications’ as an attempt to obscure the meaning of a message by making it harder to monitor! The same would apply to every other practice to minimize interference, e.g. by using directional antennas (and the power reduction they allow) to avoid spraying interference other than toward the intended recipient. Surely that was never the Commission's intention.”

Respectfully Submitted,

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